Comprehensive Exam, Example 1
CE200A

Tidal flows across intertidal mudflats are primarily driven by a free surface slope. For this problem, consider a region of this environment that is characterized by a flat bottom, and has shallow water of depth H on it. Assuming that the height of the water surface has a constant slope to it such that $dH/dx = \text{constant} < 0$ and that the depth is uniform in the other horizontal dimension, consider the following:
  (a) Simplify the governing equations to describe the flow
  (b) Solve the resulting equation assuming laminar flow conditions.

General form of governing equations (in index notation):

$$\frac{\partial \rho}{\partial t} + \rho \frac{\partial u_j}{\partial x_j} = 0$$

$$\frac{\partial u_i}{\partial t} + u_j \frac{\partial u_i}{\partial x_j} = -\frac{1}{\rho}\frac{\partial p}{\partial x_i} - g_i + \nu \frac{\partial^2 u_i}{\partial x_j \partial x_j}$$